U. S. DEPARTMENT OF COMMERCE

Technical News Bulletin

of the

National Bureau of Standards

★ *Issued Monthly* ★

Washington **August 1944**[1] **Number 328**

CONTENTS

GAS PERMEABILITY OF COATED FABRICS

During World War I, the Bureau made a study of methods for determining the rate of passage of gases through balloon fabrics. Out of that investigation an apparatus was developed that afforded a rapid and precise measurement of permeability. In the intervening quarter of a century this apparatus has been in constant use, and it is a tribute to the Bureau's mechanical facilities that little of the original construction has needed to be altered or replaced.

In the present conflict the number and variety of inflatable structures has greatly multiplied. The barrage balloon is an established tool of defense. The performance of the nonrigid airship has convinced the most skeptical of its worth in coastal patrol. Rubber landing boats and pontoons, because of their light weight and compactness, are superior to rigid structures. In the field of sea rescue devices, inflatable vests and the various types of life rafts have become essential equipment in warfare, much of which is amphibious.

In evaluating the coated fabrics entering into these structures, the Bureau's method of determining permeability, applied under the direction of T. P. Sager, of the Chemistry Division, has performed a definite function. That the rate of permeation of neoprene was early shown to be nearly one-fourth that of natural rubber determined to a considerable extent its use in balloons. Information obtained in a systematic study of the permeabilities of synthetic rubbers was of assistance when the necessity arose for substitution. The method has served as a standard for those employing other means of measuring permeability. It has been a general practice for manufacturers of fabrics to submit samples for the Bureau's determination, the test specimens employed being returned for redetermination in the manufacturer's apparatus. Occasionally such tested samples have been passed on to other manufacturers to serve repeatedly as reference standards.

The permeabilities of most types of synthetic rubbers are lower than that of natural rubber. The rate of permeation of GR–S or Buna S is, however, very nearly the same. It has long been known that different gases penetrate rubber at different rates. The permeability of rubber to helium is about two-thirds of its permeability to hydrogen. Carbon dioxide pene-

[1] Published with approval of the Director of the Budget.

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trates rubber at a rate 2.9 times that of hydrogen. A majority of the synthetic rubbers have approximately these same ratios. Rubbers of the butadiene-acrylic nitrile type differ in having about the same rates for the three gases. In the case of GR–I (Butyl Rubber) and the nonvulcanizable elastomer polyisobutylene (Vistanex) the order is reversed, the permeability to helium being slightly greater than to hydrogen and the rate of passage of carbon dioxide being slightly more than one-third that of hydrogen.

The explanation for this marked difference in behavior would appear to be a difference in the mechanism of permeation in the case of these materials. The higher relative permeability of natural rubber to carbon dioxide results from the greater solubility of this gas in rubber. In the permeation of Butyl Rubber and Vistanex, both of which are characterized by a high degree of saturation and hence relatively inert, solubility of the gas must play a less dominant part in the process, and the mechanism becomes more nearly one of diffusion alone.

LONG-TIME EXPOSURE TESTS OF METALS

Permanence in service of any structural material is, of course, of paramount importance. This is especially true, however, for aircraft material—metallic as well as nonmetallic. The light-metal alloys, unless correctly treated and processed, may be susceptible to corrosion of a very insidious type whereby the metal becomes brittle and weak without showing any marked change in surface appearance. Laboratory corrosion tests are useful for determining whether or not materials of this general class are susceptible to corrosion of this kind, but for a categorical statement in this respect, exposure tests of prolonged duration conducted in environments simulating those of service are necessary. For many years, studies of this kind have formed the basis of cooperative projects with governmental aeronautical agencies, such as the National Advisory Committee for Aeronautics and the Bureau of Aeronautics of the Navy Department.

The lack of a suitable permanent installation has long been a handicap in this work. An important requirement is that the site must be closely guarded at all times, and security be assured against encroachment from industry or any other expanding activity. After long negotiations with the Bureau of Aeronautics, such an installation has now been completed on a sea coastal site at the Hampton Roads (Virginia) Naval Air Station. This installation, which was supervised by a member of the staff of the Metallurgy Division, provides facilities for conducting exposure tests of two kinds—(1) prolonged weathering in a marine atmosphere and (2) repeated wetting by sea water. The installation, built on piles above water level at the mouth of an inlet, consists of two decks, upper and lower. The latter is close to mean water level, and the supervision of specimens so that they will be immersed twice a day at high tide involves no unusual difficulty. The height of the upper deck above water level is such that the specimens exposed there to the weathering action of the sea air are immune to accidental wetting by spray. On this deck will also be placed the racks containing the specimens that are continuously stressed in tension throughout the entire exposure period in the sea air. In the past, undesirable, but unavoidable, interruptions have occurred in these long-time exposure tests as a result of the war-time activity and expansion of this naval air station. With the completion of the new installation the chance in favor of freedom from interruption during any test is very good.

INTERFEROMETER MEASUREMENTS OF THERMAL EXPANSION OF IRON

The interferometer, as it is often used in measuring the thermal expansions of materials, fails to yield the theoretical precision claimed for this instrument and method of test. Some observers have attributed the resulting discrepancies between measurements to changes and peculiarities in the property of the materials, but others have admitted failure to find a satisfactory explanation for these discrepancies.

To show that this instrument will yield a satisfactory precision and will not give false indications of peculiarities in the expansions of materials, measurements were made by James B. Saunders, of the Bureau's Optics Division, on several samples of relatively pure iron. As pointed out in the August Journal of Research (RP1597), the agreement between the results of these tests was as good as could be expected. Furthermore, the agreement of these results with the best of those obtained by other observers was fully satisfactory. The results for the expansivities of the iron samples in

the temperature range between 0° and 400° C gave no indication of the irregularities that have been reported by some observers.

In this report, it is pointed out that these indications of the transformation in pure iron may be merely the result of the above-mentioned lack of precision of the interferometric method when it is employed in the usual manner for expansion tests. It is also shown that much of this lack of precision is caused by the tilting of the specimens that serve as spacers between the interferometer plates. The procedures required for the avoidance of these effects of tilting are described.

COMPARISON OF PLATINUM AND PALLADIUM HYDROGEN-ELECTRODES IN AQUEOUS SOLUTIONS OF ACID POTASSIUM PHTHALATE

Buffer solutions prepared with acid potassium phthalate are widely used for the calibration of commercial pH meters and equipment. A 0.05-*M* solution is generally employed and is conveniently prepared from the dry salt and distilled water. The pH value of this solution has usually been determined from the measurements of galvanic cells comprised of various types of hydrogen and calomel electrodes. However, drifting potentials for the galvanic cell have sometimes been reported, thus making impossible the establishment of the exact pH value for the solution. These drifts have been attributed to reduction of the acid potassium phthalate by the hydrogen electrode, to impurities which catalyze this reduction, to the design of the cell, to the unstable states or the unaged condition of the electrodes, to the materials used, to constantly changing potentials of the liquid junction of the solution and the potassium chloride of the calomel half-cell, and to other factors.

Other experimenters using the same kind of cells have reported satisfactory results and potentials that correspond to equilibrium conditions over a considerable period of time, thus making possible the establishment of a pH value. However, this value still included the uncertainties of the unknown potential at the junction formed between the acid potassium phthalate and the potassium chloride of the calomel half-cell.

In the August number of the Journal of Research (RP1598), W. J. Hamer and S. F. Acree report new studies of the reproducibility of hydrogen electrodes in solutions of acid potassium phthalate, and of various mixtures of orthophthalic acid and potassium hydroxide at temperatures from 0° to 60° C, inclusive. They employed silver-silver-chloride electrodes that were immersed directly in the phthalate solutions, thus eliminating liquid junctions attendant upon the use of calomel half-cells.

As a result of this recent work, it was found that the potentials of electrodes prepared with platinum sponge increased with time; that the increase was faster for the thickly plated electrodes than for the thinly plated ones; that the potentials of electrodes prepared with palladium sponge remained at the equilibrium value for a considerable time—in some cases for well over 100 hours; that the characteristics of the palladium electrodes were independent of the thickness of the palladium coating, of the current density used in the electrolysis, of the concentration, composition, acidity, and conductance of the plating solution, and of the composition, concentration, pH, and buffer capacity of the phthalate solutions in which they were used. It was also found that platinum or palladium electrodes having the same type of coating but of different age agreed in potential after 2 hours in solutions of phthalates. The different behavior of palladium and platinum hydrogen-electrodes may be explained by the differences in their catalytic activity.

DETERMINATION OF RESIDUAL WATER IN PURE SUBSTANCES

Numerous methods have been devised for determining the water present as an impurity in chemical substances. In the Journal of Research for August (RP1600) Frank W. Schwab, and Edward Wichers describe a new method which has certain advantages of simplicity and sensitivity. It is suitable not only for water, but for volatile impurities in general, in substances which can be melted without decomposition and are themselves not very volatile.

The impurity is separated by fusing the substance in a cell attached to a collecting system and allowing it to freeze slowly while the vapors are collected by pumping them into a trap of known volume, cooled by liquid air. When the trap is warmed to room temperature, the pressure of the vapor within it, if below saturation, together with the temperature and volume, determine the quantity of impurity in terms of moles and, if its identity is

known, in terms of weight. An auxiliary procedure permits the impurity to be isolated in a capillary container, as a liquid, and thus to be identified.

It was found that the current standard samples of benzoic acid (39f and 140) contain less than 0.002 percent of water and do not adsorb water on exposure to an atmosphere of high humidity. The method is further illustrated by the determination of residual solvents in acetanilide crystallized from benzene and from a mixture of alcohol and water, and of water in potassium dichromate as entrapped mother liquor.

OPTICAL ROTATION AS AN INDICATION OF MOLECULAR STRUCTURE

The importance of optical-rotation measurements is evidenced by their application to process control in many industries, of which the sugar industry may be particularly mentioned. The application of such measurements for the determination of the molecular-structure details of sugar derivatives has been described in the past in a number of articles by members of the Bureau's Polarimetry Section. This study has been continued, and in the Journal of Research for August (RP1601), William W. Pigman shows that the optical rotations of a number of acetylated substituted-phenyl β-glucosides indicate considerable interaction between certain groups in the aromatic (phenyl) portion of the molecule and the asymmetric centers in the sugar residue. The compounds which show this effect most strongly have nitro groups in the ortho position. Interaction is indicated by the marked influence of temperature on the rotation of these substances; thus, the acetylated derivatives with nitro groups in the ortho position exhibit an inversion in the sign of rotation as the temperature is raised from 20° to 150° C.

The preparation of the following new compounds is described, and their melting points and optical rotations are given: *m*-Nitrophenyl α-D-glucoside and tetraacetate, the *o,o'*-and *o,p*-dinitrophenyl β-D-glucoside tetraacetates, and the *m*-nitrobenzyl β-D-glucoside tetraacetate. The influence of temperature and of wavelength on the rotation of these and similar compounds has been determined; the rotations of the *o*-nitrophenyl β-glucoside and tetraacetate were measured in several solvents.

HYDROLYSIS OF STARCHES BY AMYLASES IN THE PRESENCE AND ABSENCE OF YEASTS

The enzymic hydrolysis of starches is the basic process for a number of important industrial operations, including the preparation of grain alcohol, beer, and certain dextrins for adhesives and sizes. The enzymes most frequently employed for these purposes are those found in barley malt. Other sources of similar enzymes have long been known, but their general application in place of malt has not been practicable because of the lack of knowledge of their action. In conjunction with the Wheat-Alcohol Committee of the War Production Board, William W. Pigman of the Bureau's polarimetry section has studied the application of various types of enzyme preparations for the conversion of starches into substances fermentable by yeasts. The more important results of the work, as applied to commercial starches, are reported in RP1599 in the August Journal of Research. An investigation of the extent of hydrolysis of starches by amylases has revealed that enzyme preparations made from certain molds (*aspergillus* species), as well as barley malt, are able to break down starches completely to fermentable sugars in the presence of yeasts. Enzyme preparations made from some bacteria (*Bacillus mesentericus*) and from pancreases do not break down starches completely to fermentable sugars, even if the enzymic action takes place in the presence of yeasts. The so-called β-amylases, found particularly in wheat and soy beans, also do not bring about complete saccharification. For certain of these enzyme types, the apparent absence of complete hydrolysis to fermentable sugars seems to be due to the synthesis of unfermentable materials from the products of hydrolysis. The synthesis of such substances by the action of the enzyme preparations on maltose is demonstrated, and the nature of the actions of the various types of enzymes which hydrolyze starch are discussed in relation to the structures of the various starch substances. A procedure for the liquefaction of starch suspensions without the intermediate formation of gels is given.

REVISED COMMERCIAL STANDARD FOR TESTING TEXTILES

The fourth edition of CS59–44, Textiles—Testing and Reporting, is now available. This is a revision of CS59–

41, which is in wide use by textile testing laboratories.

For some years laboratory tests on textiles continued to increase in number, both before purchase by textile commodity manufacturers and retailers and after complaints by users. This increase can be traced largely to women purchasers who, having experienced difficulties with textiles, such as fading, shrinking, stretching, and yarn slippage at the seams, complained of these defects to the retailers.

So important had this matter of testing become by 1934 and so varied were the test methods developed by commercial laboratories that the National Retail Dry Goods Association requested the cooperation of the Bureau in developing a commercial standard to unify methods of testing and of reporting results of tests on woven dress fabrics.

The commercial standard, originally drafted by a committee of testing laboratory representatives and later adjusted and approved by the trade, was first put into effect on April 15, 1936.

Since then, two revisions other than the present one have been issued, the first in 1939 and the second in 1941. The 1939 revision included new methods covering colorfastness to perspiration, wet pressing, and certain refinements to keep the standard abreast of progress. The revision of 1941 was the result of an investigation conducted during the latter part of 1939 by the Technical Committee of the National Association of Finishers of Textile Fabrics, prior to the adoption of new colorfastness specifications for dyed and printed cotton fabrics.

The present revision, undertaken at the request of the Textile Fabrics Association, the National Association of Dyers and Cleaners, and the American Association of Textile Chemists and Colorists, provides nationally recognized methods of testing and reporting results of tests on textiles to determine breaking strength of woven fabrics under atmospheric and wet conditions; bursting strength of knit textiles; colorfastness to chlorine, crocking (rubbing), cleaning (dry and wet), atmospheric gases, laundering, light, perspiration, and pressing (dry and wet); shrinkage in cleaning (dry and wet) and laundering; and resistance to yarn slippage (resistance to pulling out of seams at points of stress.) The methods apply to textiles composed of cotton, linen, wool, rayon, and other synthetic fibers and mixtures thereof.

Provision is made for five degrees of fastness to light; four of fastness to laundering for cotton, linen, or rayon textiles; and one of fastness to laundering of textiles composed of wool, silk, and synthetic fibers other than rayon, based on an "appreciable change." This term has the same meaning as in the previous edition—that is, a change which, under good light conditions, is immediately noticeable on comparison of the tested sample with the original, or, in the case of staining, when the stain is immediately noticeable on the attached white cloth. If closer inspection or altered lighting is required in any of the above tests to make the change apparent, the change is not considered "appreciable."

The standard also provides for the use of standard dyeings of the American Association of Textile Chemists and Colorists in the calibration of certain testing apparatus.

With the information provided for these tests, it should be fairly easy to determine whether a new fabric is or is not suitable for a given use. The pamphlet includes a brief history of the project, a list of official acceptors, and the membership of the Standing Committee. Copies are available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 10 cents each.

COMMERCIAL STANDARD FOR MINERAL WOOL INSULATION

Commercial Standard CS117–44, Mineral Wool: Blankets, Blocks, Insulating Cement, and Pipe Insulation for Heated Industrial Equipment, was recently released in printed form. This standard establishes minimum specifications for insulating heated surfaces with mineral wool products for the guidance of manufacturers, distributors, installers, contractors, engineers, and users so as to avoid delays and misundertandings when making installations and to provide a standard basis for certifying quality of material and installation. It provides minimum requirements for mineral wool blankets, blocks, insulating cement, and pipe insulation for use on heated industrial equipment. It covers requirements for material, thermal conductivity, density, standard sizes, and tolerances. The standard also lists the recommended minimum insulation thickness required for various operating temperatures and recommended methods of installation. The range of types, conductivities, classes, temperature limits, and sizes of mineral wool products for insulating heated industrial equipment are shown in a table. Other tables give pertinent information

on insulation of each class and numerous drawings show the approved methods of application.

Copies of CS117–44 are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 10 cents each.

TEMPERATURES DEVELOPED IN CHIMNEYS FOR LOW-COST HOUSES

Low-cost and special defense housing construction has invited the use of chimneys that are much lighter, less expensive, and less permanent than the conventional brick construction. Because of their low cost, lightly constructed and partially prefabricated designs have been submitted to the Bureau. The testing of these has called for considerable special equipment.

To aid in establishing performance requirements, tests were conducted recently with a lined and unlined brick chimney, both having 4-in.-thick clay brick walls. A constant flue-gas temperature was obtained with a gasburner at the base of the chimney. Surrounding the chimney above the burner inlet was a floor construction representative of details applied in dwellings. The floor joists were spaced 2 in. away from the chimney, but the edges of the floor boards and the nailing strips for the base trim were in contact with the chimney, except that for the unlined chimney and for one side of the lined chimney, a single thickness of 15-lb absestos paper was placed between the brick and the wood. It was found that the unlined chimney created a hazardous condition to the surrounding woodwork with a continued flue-gas temperature of 900° F, and the lined chimney with a flue-gas temperature of 1,100° F. However, this condition did not obtain for the lined chimney until after 13 hours, and a slightly shorter period for the unlined chimney.

A number of firing tests were conducted with heating equipments known to give high flue-gas temperatures, using wood and soft coal as fuels. With a coal-fire jacketed-type heater, flue-gas temperatures at the floor level above the heater of 1,200° to 1,300° F obtained for an hour or more. With wood fuel, the temperature peaks would be higher but persist for shorter periods.

P. H. BATES ELECTED PRESIDENT OF AMERICAN SOCIETY FOR TESTING MATERIALS

At the 47th annual meeting of the American Society for Testing Materials, held in New York City on June 26–30, Phaon H. Bates, chief of the Bureau's Clay and Silicate Products Division, was elected president of the Society for the year 1944–45. Mr. Bates is the third Bureau man to attain this honor; the others were George K. Burgess (1922–23) and G. E. F. Lundell (1941–42).

The ASTM, as it is familiarly known, was organized in 1898 as the American section of the International Association for Testing Materials, and was incorporated as an independent society in 1902. It has two objectives—the promotion of knowledge of the materials of engineering, and the standardization of specifications and methods of testing. The first is "effected through investigations and research by committees and individual members of the Society, and by joint researches with other groups," whereas the second is accomplished chiefly by 60 standing committees, each of which deals with engineering materials in a definitely prescribed field or some specific phase of materials testing. Bureau men hold 95 memberships on 52 of these committees. The Society's members number over 5,200 individuals and firms, having increased by more than 350 during the past year.

ASTM specifications are used by the majority of private firms and by many State, county, and municipal purchasing agents in this country. They are referred to in building, plumbing, and other codes, and are accepted as standard in their particular fields.

The Society cooperates with the specifications committees of the War and Navy Departments, the War Production Board, and many other Federal agencies besides the Bureau. The results of its research work are published in part in a monthly Bulletin and as preprints before the annual and spring meetings. An annual volume of Proceedings, which contains the remainder of the research reports, appears usually in December, and all of the ASTM standards and tentative standards are available in pamphlet form.

COLUMBIA UNIVERSITY CONFERS DOCTORATE OF SCIENCE ON LYMAN J. BRIGGS

The degree of doctor of science was conferred on Lyman J. Briggs, Director of the Bureau, by Columbia University at the 119th commencement of that institution. The citation was as follows:

> Lyman James Briggs: Physicist; native of Michigan who quickly turned to scientific work of high importance and passed from one post of honor and confidence to another; becoming in 1933 director of the Bureau of Standards; closely associated with a score of important scientific organizations and undertakings; always a stimulating leader in thought and research.

NEW AND REVISED PUBLICATIONS ISSUED DURING JULY 1944

Journal of Research[2]

Journal of Research of the National Bureau of Standards, volume 32, number 6, June 1944 (RP1588 to RP1591, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers[2]

[Reprints from the May 1944 Journal of Research]

RP1584 Method for determining individual hydrocarbons in mixtures of hydrocarbons by measurement of freezing points. Anton J. Streiff and Frederick D. Rossini. Price 5 cents.

RP1585. Theoretical analysis of certain time-temperature freezing and melting curves as applied to hydrocarbons. William J. Taylor and Frederick D. Rossini. Price 5 cents.

RP1586. A method for the determination of the pH of 0.05-molal solutions of acid potassium phthalate with or without potassium chloride. Walter J. Hamer and S. F. Acree. Price 5 cents.

RP1587. Thermal properties of moist fabrics. Charles W. Hock, Arnold M. Sookne, and Milton Harris. Price 5 cents.

Commercial Standards[2]

CS59–44. Textiles—testing and reporting (Supersedes CS59–41). Price 10 cents.

CS117–44. Mineral wool: blankets, blocks, insulating cement, and pipe insulation for heated industrial equipment. Price 10 cents.

Technical News Bulletin[2]

Technical News Bulletin No. 327, July 1944. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC755. List of Commercial Standards. (Supersedes LC745.)

LC756. Drainpipe cleaners or solvents. (Supersedes LC341.)

LC757. Volume correction factors for C_4 hydrocarbon mixtures.

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS[3]

Equipment and method for measurement of power factor of mica. E. L. Hall. Proceed. Inst. Radio Engineers (330 West 42d St., New York 18, N. Y.) 32, No. 7, 393 (July 1944).

Discussion of the symposium on the significance of the hardness test of metals in relation to design. L. B. Tuckerman. Proceed. Am. Soc. Testing Materials (260 South Broad St., Philadelphia, Pa.) 43, 847 (1943).

Characteristics of the Tuckerman strain gage. Bruce L. Wilson. Preprint 94 at 47th annual meeting, Am. Soc. Testing Materials (June 26–30, 1944).

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, $3.50 a year (to addresses in the United States and its possessions and in countries extending the franking privilege) other countries, 70 cents and $4.50, respectively.

[3] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

Effect of a small hole on the stresses in a uniformly loaded plate. M. Greenspan. Quar. Applied Mathematics (Brown University, Providence, R. I.) 2, No. 1, 60 (April 1944).

Morphology of latex particles as shown by electron micrographs. S. B. Hendricks, S. G. Wildman, and H. F. McMurdie. India Rubber World (1309 Noble St., Philadelphia 23, Pa.) 110, No. 3, 297 (June 1944).

The relation of the National Bureau of Standards to the textile industry. William D. Appel. Am. Dyestuff Reporter (440 Fourth Ave., New York 16, N. Y.) 33, No. 9, 182 (April 24, 1944).

Compression meter for evaluating the compressibility and resilience of fabrics. Edwin C. Dreby. Am. Dyestuff Reporter, 33, No. 10, 199 (May 8, 1944).

The chemists' wonderland: Plastics through the looking glass. Gordon M. Kline. Chemical and Engineering News (1155 16th St., N. W., Washington 6, D. C.) 22, 890 (June 10, 1944).

The technical cohesive strength of some steels and light alloys at low temperatures. D. J. McAdam, Jr., R. W. Mebs, and G. W. Geil. Preprint 27 at 47th annual meeting, Am. Soc. Testing Materials (260 S. Broad St., Philadelphia, Pa.) (June 26–30, 1944).

Short time tests of solders and soldered joints. J. A. Kies and W. F. Roeser. Preprint 32 at 47th annual meeting, Am. Soc. Testing Materials. (June 26–30, 1944).

Simplified practice in long-view planning. Edwin W. Ely. Southwestern Purchasing Agent (Park Central Bldg., 412 West 6th St., Los Angeles 14, Calif.) 28, No. 12, 159 (June 1944).

Misconceptions in mathematics and physics—what shall we do about them? L. B. Tuckerman. Am. J. Physics (57 East 55th St., New York 22, N. Y.) 12 No. 2, 75 (April 1944).

U. S. GOVERNMENT PRINTING OFFICE: 1944